

Understanding the Composition of Tissue in Skin Cancer using Synchrotron Infrared Micro-Spectroscopy

M. Hershcovitch (Mt. Sinai High School), L. McIntosh (Institute for Biodiagnostics, NRC of Canada) and L. Miller (BNL, NSLS)

Abstract No. Hers1794

Beamline(s): U10B

Infrared micro-spectroscopy is useful for identifying the chemical composition of many biological tissues because lipids, proteins, nucleic acids, and carbohydrates all have unique infrared spectra. By collecting infrared micro-spectra over areas of tissue and integrating the area under the peaks representative of each component, 8-bit grayscale images can be generated for each chemical component in the tissue (**Figure 1**). Correlation between these components can be visualized by combining three 8-bit grayscale images into a single RGB 24-bit image (i.e. digital staining). Thus, digital staining provides a unique method for identifying and visualizing a chemical map of biological tissue.

In this work, we have examined normal skin and malignant skin melanoma. Results illustrate that normal tissue has composition differences between epidermis, dermis, and hair follicle regions. We observe high lipid content in the epidermis and follicle sheath and high nucleic acid content in the dermis (**Figure 2**). The skin sample containing a malignant tumor showed a relatively uniform distribution of lipids, proteins, and nucleic acids. However, by imaging only collagen instead of all proteins, we observed high concentrations of collagen around tumor tissue boarder areas. Collagen structure and concentration are important because tumor cells must degrade collagen (as part of the extracellular matrix) for tumors to grow. Tumor cells have been found to express enzymes in high concentration that degrade collagen. Thus the location of collagen in tissue is important to the direction of tumor growth. We have also found that there is a higher concentration of nucleic acids in tumor tissue, suggesting an increase in DNA replication. These results provide a better understanding of how cancer cells operate on extra-cellular matrix. Chemical differences found in the spectra may facilitate a better understanding of tumor growth.

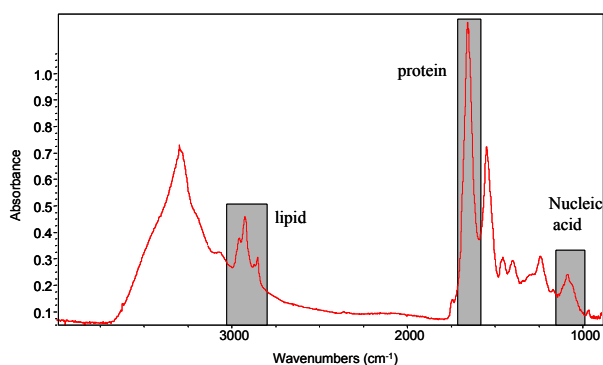


Figure 1. Infrared spectrum of skin tissue. Highlighted peaks are integrated to determine lipid, protein, and nucleic acid content, respectively.

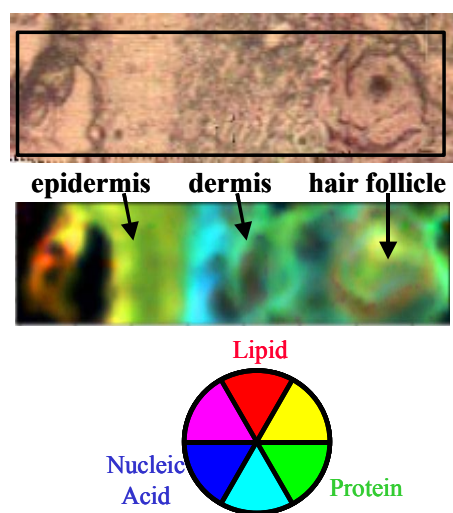


Figure 2. (Top) Visible image of normal skin tissue containing epidermis, dermis, and a hair follicle. (Middle and Bottom) 24-bit RGB image of the above skin tissue. Lipids, proteins, and nucleic acids were placed in the red, green, and blue channels, respectively.